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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of

Hyun-doo SHIN, et al.

Docket No: Q59549

Appln. No.: 09/823,272

Group Art Unit: 2625

Confirmation No.: 7285

Examiner: Yubin Hung

Filed: April 2, 2001

For: STATISTIC BASED VECTOR APPROXIMATION FILE: A DATA STRUCTURE FOR INDEXING IN HIGH DIMENSIONAL SPACE

RESPONSE TO NOTICE OF NON-COMPLIANT
APPEAL BRIEF UNDER 37 C.F.R. § 41.37

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Notification of Non-Compliant Appeal Brief dated September 15, 2006, Applicants are submitting herewith a new Appeal Brief that obviates the deficiency noted in the Notification.

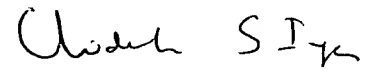
In particular, Applicant has addressed the issues identified in the Notification where necessary. Specifically, the Examiner contends that the Applicants have not indicated the status of the claims and that each new argument does not begin in a new page. The Applicants respectfully submit that Section III includes a status of the claims and the two arguments begin on pages 14 and 19.

The Applicants have revised the section on the claimed subject matter to include additional references to the Specification by page and line numbers.

Applicants respectfully submit that the new brief complies with the rules and therefore requests an Examiner's Answer.

Although Applicant believes that no fee is due, the USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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23373
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Date: October 16, 2006

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 41.37 Appellants are submitting an Appeal Brief to appeal from the Final Office Action dated January 20, 2006 (hereinafter "the Final Office Action"), wherein rejection of claims 1, 3-8 and 10-13 have been maintained. This Appeal Brief is accompanied by a Submission which includes the required appeal fee set forth in 37 C.F.R. § 41.20(b)(2). Appellants' Notice of Appeal was filed on May 22, 2006.

Table of Contents

I. REAL PARTY IN INTEREST

The real parties in interest are SAMSUNG ELECTRONICS CO., LTD. and THE REGENTS OF THE UNIVERSITY OF CALIFORNIA (Assignees) by virtue of an assignment executed by Mr. Hyun-Doo SHIN and Mr. Yang-Lim CHOI, the co-inventors on July 4, 2001 (SAMSUNG ELECTRONICS), and recorded by the Assignment Branch of the U.S. Patent and Trademark Office on July 9, 2001 (at Reel 011961, Frame 0824) and by virtue of an assignment executed by Mr. Bangalore S. MANJUNATH and Mr. Peng WU, the co-inventors on June 21, 2001 and June 27, 2001 (REGENTS OF THE UNIVERSITY OF CALIFORNIA), and recorded by the Assignment Branch of the U.S. Patent and Trademark Office on July 9, 2001 (at Reel 011961, Frame 0828).

II. RELATED APPEALS AND INTERFERENCES

Upon information and belief, there are no other prior or pending appeals, interferences, or judicial proceedings known to Appellants, Appellants' representatives or the Assignee that may be related to, be directly affected by, or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Each of pending claims 1, 3-8 and 10-13 are finally rejected (see Final Office Action dated January 20, 2006). **These claims are under appeal.**

Each of claims 2 and 9 are canceled (see Final Office Action dated January 20, 2006).

IV. STATUS OF AMENDMENTS

There are no pending unentered amendments in this case.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The present invention relates to an indexing method of a feature vector data space, and more particularly, to an indexing method for finely indexing cells having a high concentration of feature vectors by hierarchically approximating the feature vectors depending on their distribution in a feature vector data space.

Fast and efficient access to a database is desired for a significant number of applications commonly used today. Specifically, managing such databases that include multimedia data and providing methods to access the multimedia data has become increasingly important. In such multimedia data, a few hundred thousand to a few million or more items is not uncommon. For each object (or record) in such a multimedia database, the degree of the data (for example, the dimensionality of the attributes in the data) is much higher than that in a conventional database.

Feature vectors are a convenient way of representing such high degree, multi-dimensional data. A collection of feature vectors that form part of an application can be termed as a feature vector data space.

Efficient indexing methods are required to access a database that stores feature vectors. Some indexing methods aim at minimizing storage overhead, while others may focus on efficiently supporting the range of queries. The present invention is aimed at provide an indexing method for a database that stores a feature vector data space. Further, in the present invention, the feature vectors are classified into uniform-sized cells and cells in which a high concentration of feature vectors exist are more finely indexed.

A computer-readable recording medium for storing program codes used for performing the indexing method of a feature vector data space as well as a similarity searching method of performing a similarity search in such a feature vector data space are also provided for the present invention.

Claims 1, 3-6

Claims 1, 3-6 are directed to indexing method of a feature vector data space in which a plurality of feature vectors are indexed. The claims reciting *inter alia*: partitioning the feature vector data space into a plurality of cells having a uniform size. (Specification p. 5, ll. 18-20). Determining whether one or more cells, on each of which one or more of said plurality of feature vectors are correspondingly concentrated, exist. (Specification p. 6, ll. 4-8). Hierarchically indexing the feature vector data space when it is determined that said one or more cells, on each of which said one or more of said plurality of feature vectors are correspondingly concentrated, exist. (Specification p. 6, ll. 14-18). One or more feature vectors are said to be concentrated in a cell when the cell contains more feature vectors than a predetermiend threshold. (Specifiction p. 6, ll. 11-13).

Claims 7, 8, 10 and 11

Claims 7, 8, 10 and 11 recite a computer programming product comprising instructions to implement the method discussed above. (Specification p. 9. ll. 1-7).

Claims 12-13

Claims 12-13 recite methods for searching for similarity in a feature vector data space in which feature vectors are indexed. The claims recite *inter alia:* performing a similarity search in

the feature vector data space, which has been indexed, by determining whether each of one or more cells, on which the feature vectors are correspondingly concentrated, exists and hierarchically indexing the feature vectors in said each of one or more cells, on which it is determined that the feature vectors are correspondingly concentrated, according to a predetermined indexing method. (Specification p. 6, ll. 4-18).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The issues on appeal are whether the following rejections are proper:

1. Rejection of claims 1, 3, 7, 12 and 13 under 35 U.S.C. 103(a) based on Wan et al. ("A New Approach to Image Retrieval with Hierarchical Color Clustering," *IEEE Trans. on Circuits and Systems for Video Technology,* Vol. 8, No. 5, Sep. 1998, pp. 628-643), in view of Kothuri et al. (U.S. Patent No. 6,381,605).

2. Rejection of claims 4-6, 8, 10 and 11 under 35 U.S.C. 103(a) based on Wan et al. ("A New Approach to Image Retrieval with Hierarchical Color Clustering," *IEEE Trans. on Circuits and Systems for Video Technology,* Vol. 8, No. 5, Sep. 1998, pp. 628-643) and Kothuri et al. (U.S. Patent No. 6,381,605) as applied to claims 1, 3, 7, 12, 13 above, and further in view of Weber et al. ("A Quantitative Analysis and Performance Study for Similarity-Search Methods in High-Dimensional Spaces," *Proceedings of the 24th International Conference on Very Large Data Base, New York, August 1998, pp. 194-205).*

VII. ARGUMENT

Rejection of claims 1, 3, 7, 12, 13 based on Wan et al. in view of Kothuri et al.

Claim 1 requires the cells to be uniform. Further, claim 1 requires determining whether one or more cells **from said plurality of cells**, on each of which one or more of said plurality of feature vectors are correspondingly concentrated, exist. If so, the hierarchical indexing is performed on the feature vector data space. One or more feature vectors are considered to be concentrated in a cell when the cell contains more feture vectors than a predetermiend threshold

Wan is used by the Examiner for its alleged teaching that a feature vector space is partitioned into a plurality of cells having a uniform size.

The Examiner uses Kathuri for its alleged teaching about checking to determine whether one or more cells **from said plurality of cells**, on each of which one or more of said plurality of feature vectors are correspondingly concentrated, exist and its performing hierarchical indexing on the feature vector data space.

In rejecting claim 1, the Examiner refers to Figs. 3 & 5, numerals 506 and 518 and 14-55-15:43 of Kothuri in alleged support for determining whether one or more cells, on each of which one of more of said plurality of feature vectors are correspondingly concentrated exist.

Further the Examiner refers to 3:27-37 and 14:55-56 in alleged support for hierarchically indexing the feature vector data space if such one or more cells exist.

As an initial matter, Kothuri does not disclose any feature vector space. Kothuri is related to indexing of multi-dimensional or multi-attribute data. While feature vectors could have more than one dimensions, a general teaching on multi-dimensional data cannot be

considered to be a specific disclosure related to a feature vector space where the number of dimensions are significantly higher.

Kothuri follows a completely different approach for hierarchically indexing multi-dimensional data. Even the individual steps in the hierarchical indexing do not refer to determining cells in which feature vectors are concentrated.

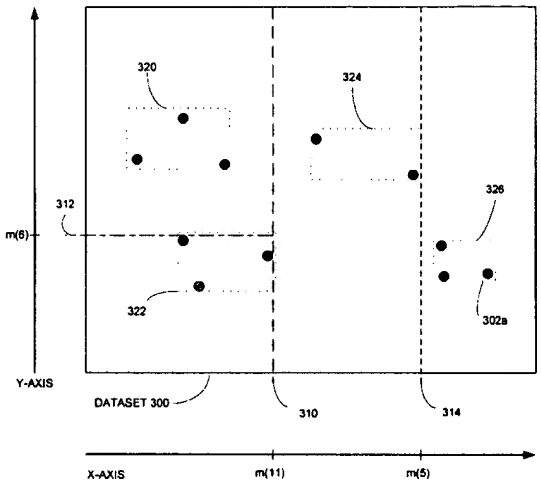

320
324
326
312
m(6)
322
302a
Y-AXIS
DATASET 300
310
314
X-AXIS
m(11)
m(5)

FIG. 3

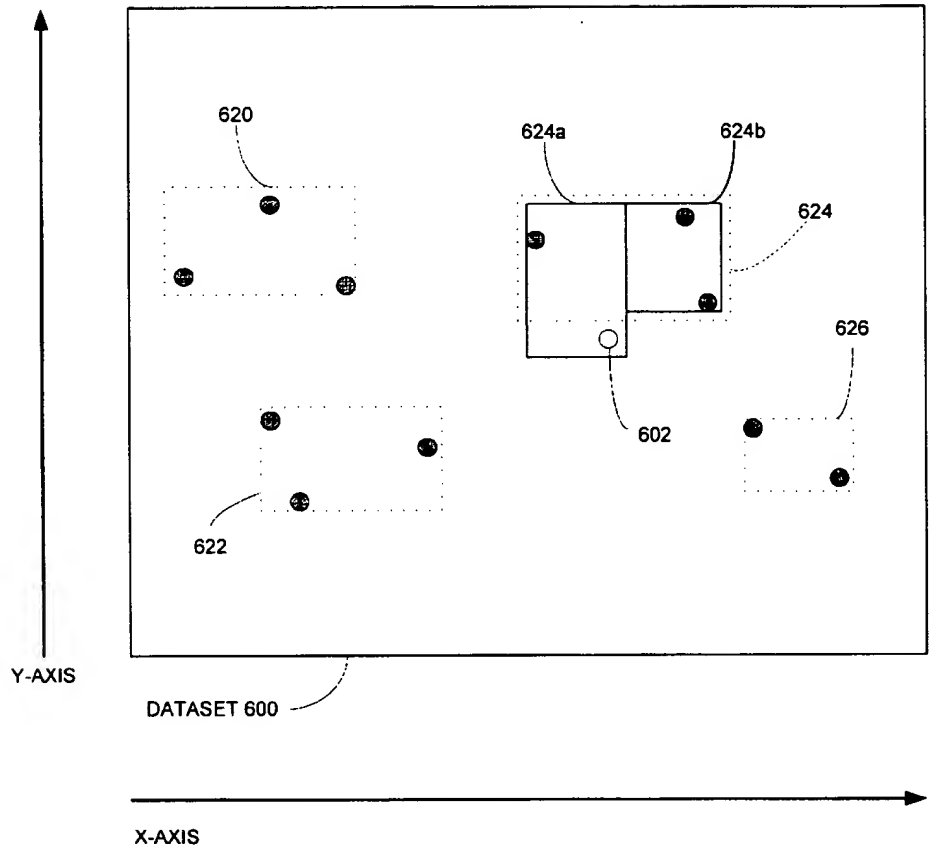


FIG. 6A

Referring to Figs 3 and 5 of Kothuri, dataset 300 comprises multiple data points that vary more in the x dimension than the y dimension. They are sorted according to their values in the x dimension. An effective location for a first division is determined based on a median

computation, which is illustrated by dividing line 310. After the first partition, it is determined whether each new subset of data will fit into a single R-tree node. Each subset that is too large (i.e., each subset that contains more than M data points) is further divided in a similar manner. Further divisions are performed till each subset can fit into a single node.

As described in the flowchart of Fig. 5, in step 506 it is determined if the data items fit into one node. If they do not fit, the variance in each dimension is determined. Then a dimension or attribute hierarchy having a greatest variance is selected and the data items sorted in that dimension. In step 514 the data items are divided in the selected dimension into two or more subsets. An approximate median may be computed as described above in order to divide the data items in half as nearly as possible. Alternatively, the data items may be divided into a number of clusters, each of which contains a number of data items that will fit into one leaf node.

As noted above, clearly, the emphasis is on dividing the data into subsets such that each data will fit into a leaf node. On the other hand, in the present invention, as recited in claim 1, as amended, the cells are divided into a plurality of cells having a **uniform size** regardless of whether they will fit into a particular cell or sub-cell. After that it is determined if cells where a plurality of feature vector space are concentrated exist. This is done by determining if there are more number of cells than a predetermined threshold. If they exist, then the vector data space is hierarchically indexed.

The difference between the present invention and Kothuri are clear from the respective illustrations in Fig. 3 and 6A of Kothuri and Figs 2-3 of the present Specification.

As shown in Fig. 3, based on variance information, Kothuri decides how the data is subdivided. For example, lines 310, 312 and 314 are drawn at appropriate locations based on the variance of the data. Then sub-divisions that have more data are then subdivided further, again based on variance. In Fig. 6A, clusters 620, 622, 624 and 626 of data are generated based on the amount of data that can be stored in a leaf node.

On the other hand, as shown in Fig. 2 of the present Specification, the data is divided into uniform cells 00 00, 00 01, etc. Further, the cells 20 and 22 that have feature vectors concentrated are determined. Then these cells are further divided as shown in Figs 3A and 3B.

Even if a node of Kothuri is read on the cell/sub-cell of the present invention, as the Examiner appears to be doing, the above steps of Kothuri are significantly different from determining the cells in which feature vectors are concentrated.

Further Kothuri does not teach uniform cells. Kothuri suggests dividing the data into subsets such that each data will fit into a leaf node. On the other hand, in the present invention, as recited in claim 1 as well as in Wan (as alleged by the Examiner) the cells are divided into a plurality of cells having a uniform size regardless of whether the data will fit into a particular cell or sub-cell.

Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. MPEP 2143.01 *citing In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

Further, if the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *Id. citing In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

To combine the teachings of Wan and Kothuri, considerable modification would be required to the respective teachings of Wan and Kothuri. If Wan is modified to have the non-uniform cells as in Kothuri, it will be unsatisfactory for its intended purpose. In fact, the last paragraph of page 631 clearly discusses why Wan prefers uniform sizes. Likewise, Kothuri can not be modified to have uniform cell sizes because the rest of the steps in Kothuri are based on the assumption that the division is determined based on a median computation. Kothuri determines if the data items fit into one node. If they do not fit, the variance in each dimension is determined. Then a dimension or attribute hierarchy having a greatest variance is selected and the data items sorted in that dimension. The data is divided into subsets such that each data will fit into a leaf node. If the cells are uniform, then this technique is not believed to produce its intended result.

Even if the references are combined, they do not suggest determining whether one or more cells from said plurality of (uniform-sized) cells as required by the present invention.

Kothuri suggests dividing into a number of clusters, each of which contains a number of data items that will fit into one leaf node. Checking to see if there are uniform-sized cells where feature vectors are concentrated and hierarchically partitioning them, as in the present invention, is different from dividing the data set into non-uniform subsets such that each data will fit into a leaf node.

A skilled artisan would not have found it obvious to practice the invention recited in claim 1 from the combined teachings of Wan and Kothuri.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. MPEP 2142 *citing In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

The Examiner has not satisfied the burden of establishing *prima facie* obviousness at least because it has not satisfied at least the "all limitations" and "motivation" prongs of the three prong test for obviousness. Specifically, the Examiner has not shown that the combined teachings of Wan and Kathur suggest the present invention as a whole, including the requirement of determining whether one or more cells **from said plurality of cells**, on each of which one or more of said plurality of feature vectors are correspondingly concentrated, exist and performing hierarchical indexing on the feature vector data space.

Claim 3 is dependent on claim 1 and is allowable for the same reasons.

Claims 7, and 12 include limitations analogous to claim 1 and are allowable at least for analogous reasons.

Claim 13 is dependent on claim 12 and is allowable for the same reasons.

Rejection of claims 4, 6, 8, 10 and 11 based on Wan et al. in view of Kothuri et al. and Weber

Claims 4 and 6 are dependent on claim 1 and are allowable for the same reasons.

Claims 8, 10 and 11 are dependent on claim 7 and are allowable for the same reasons.

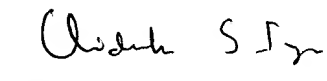
Moreover, Weber does not overcome the deficiency noted in the combined teachings of Wan and Kothuri.

VIII. CONCLUSORY REMARKS

Unless a check is submitted herewith for the fee required under 37 C.F.R. §41.37(a) and 1.17(c), please charge said fee to Deposit Account No. 19-4880.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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Date: October 16, 2006

CLAIMS APPENDIX

CLAIMS 1, 3-8 and 10-13 ON APPEAL:

1. An indexing method of a feature vector data space in which a plurality of feature vectors are indexed, the indexing method comprising the steps of:

(pa-1) partitioning the feature vector data space into a plurality of cells having a uniform size;

(a) determining whether one or more cells from said plurality of cells, on each of which one or more of said plurality of feature vectors are correspondingly concentrated, exist; and

(b) hierarchically indexing the feature vector data space when it is determined that said one or more cells, on each of which said one or more of said plurality of feature vectors are correspondingly concentrated, exist in the step (a)

wherein, one or more feature vectors are concentrated in a cell when the cell contains more feture vectors than a predetermiend threshold.

2. canceled.

3. The indexing method of claim 1, wherein the step (a) comprises the sub-steps of:

(a-1) constructing a histogram illustrating a number of said plurality of feature vectors in each of a plurality of cells, including said one or more cells; and

(a-2) analyzing a distribution of said plurality of feature vectors using the histogram and determining whether said one or more cells, on each of

which said one or more of said plurality of feature vectors are correspondingly concentrated, exist.

4. The indexing method of claim 1, wherein the step (b) comprises the step of indexing the feature vector data space using a vector approximation file.

5. The indexing method of claim 4, wherein the step (b) comprises the sub-steps of:

(b-1) constructing a sub-vector approximation file over each of said one or more cells, on which said one or more of said plurality of feature vectors are correspondingly concentrated; and

(b-2) approximating said one or more of said plurality of feature vectors in said each of said one or more cells, on which said one or more of said plurality of feature vectors are correspondingly concentrated, using the vector approximation file and a corresponding sub-vector approximation file.

6. The indexing method of claim 1, wherein the step (b) comprises the sub-steps of:

(b-1) partitioning each of said one or more cells into a corresponding plurality of sub-cells, when it is determined that said each of said one or more cells, on which said one or more of said plurality of feature vectors are correspondingly concentrated, exists in the step (a); and

(b-2) approximating said one or more of said plurality of feature vectors in said each of said one or more cells, using said corresponding plurality of sub-cells, thereby hierarchically indexing the feature vector data space.

7. A computer-readable recording medium for storing program codes for performing an indexing method of a feature vector data space in which a plurality of feature vectors are indexed, the indexing method comprising the steps of:

(pa-1) partitioning the feature vector data space into a plurality of cells having a uniform size;

(a) determining whether one or more cells, from among said plurality of cells, on each of which one or more of said plurality of feature vectors are correspondingly concentrated, exist; and

(b) hierarchically indexing the feature vector data space when it is determined that said one or more cells, on each of which said one or more of said plurality of feature vectors are correspondingly concentrated, exist in the step (a)

wherein, one or more feature vectors are concentrated in a cell when the cell contains more feture vectors than a predetermiend threshold.

8. The computer-readable recording medium of claim 7, wherein the step (b) comprises the step of indexing the feature vector data space using a vector approximation file.

9. canceled.

10. The computer-readable recording medium of claim 7, wherein the step (b) comprises the sub-steps of:

(b-1) partitioning each of said one or more cells into a corresponding plurality of sub-cells, when it is determined that said each of said one or more cells, on which said one or more of said plurality of feature vectors are correspondingly concentrated, exists in the step (a); and

(b-2) approximating said one or more of said plurality of feature vectors in said each of said one or more cells, using said corresponding plurality of sub-cells, thereby hierarchically indexing the feature vector data space.

11. The computer-readable recording medium of claim 8, wherein the step (a) comprises the sub-steps of:

(a-1) constructing a histogram illustrating a number of said plurality of feature vectors in each of a plurality of cells, including said one or more cells; and

(a-2) analyzing a distribution of said plurality of feature vectors using the histogram and determining whether said one or more cells, on each of which said one or more of said plurality of feature vectors are correspondingly concentrated, exist, and

the step (b) comprises the sub-steps of:

(b-1) constructing a sub-vector approximation file over each of said one or more cells, on which said one or more of said plurality of feature vectors are correspondingly concentrated; and

(b-2) approximating said one or more of said plurality of feature vectors in said each of said one or more cells, on which said one or more of said plurality of feature vectors are

correspondingly concentrated, using the vector approximation file and a corresponding sub-vector approximation file.

12. A method of searching for similarity in a feature vector data space in which feature vectors are indexed, the method comprising the step of (a) performing a similarity search in the feature vector data space, which has been indexed, by determining whether each of one or more cells, from among a plurality of uniformly sized cells, on which the feature vectors are correspondingly concentrated, exists and hierarchically indexing the feature vectors in said each of one or more cells, on which it is determined that the feature vectors are correspondingly concentrated, according to a predetermined indexing method.

13. The method of claim 12, wherein the step (a) is performed based on a nearest neighbor search.

EVIDENCE APPENDIX:

None.

RELATED PROCEEDINGS APPENDIX

None.